Brain injury after subarachnoid hemorrhage

The concept of “early brain injury” (EBI) after SAH has been recently introduced and encompasses several disorders occurring within the first 72 h following the aneurysm rupture [1)]

Multimodal neuromonitoring techniques allow insight into pathophysiologic changes in the early phase after aSAH. The results may be used as endpoints for future interventions targeting EBI in poor-grade aSAH patients [2)].

A study aimed to investigate the neuroprotective effect of ERRγ activation against early brain injury (EBI) after subarachnoid hemorrhage (SAH) and the potential underlying mechanisms. In a rat model of SAH, the time course of ERRs and SIRT3 and the effects of ERRγ activation were investigated. ERRγ agonist DY131, selective inhibitor GSK5182, or SIRT3 selective inhibitor 3-TYP were administered intracerebroventricularly (icv) in the rat model of SAH. The use of 3-TYP was for validating SIRT3 as the downstream signaling of ERRγ activation. Post-SAH assessments included SAH grade, neurological score, Western blot, Nissl staining, and immunofluorescence staining in rats. In an vitro study, the ERRγ agonist DY131 and ERRγ siRNA were administered to primary cortical neurons stimulated by Hb, after which cell viability and neuronal deaths were accessed. Lastly, the brain ERRγ levels and neuronal death were accessed in SAH patients. They found that brain ERRγ expressions were significantly increased, but the expression of SIRT3 dramatically decreased after SAH in rats. In the brains of SAH rats, ERRγ was expressed primarily in neurons, astrocytes, and microglia. The activation of ERRγ with DY131 significantly improved the short-term and long-term neurological deficits, accompanied by reductions in oxidative stress and neuronal apoptosis at 24 h after SAH in rats. DY131 treatment significantly increased the expressions of PGC-1α, SIRT3, and Bcl-2 while downregulating the expressions of 4-HNE and Bax. ERRγ antagonist GSK5182 and SIRT3 inhibitor 3-TYP abolished the neuroprotective effects of ERRγ activation in the SAH rats. An in vitro study showed that Hb stimulation significantly increased intracellular oxidative stress in primary cortical neurons, and DY131 reduced such elevations. Primary cortical neurons transfected with the ERRγ siRNA exhibited notable apoptosis and abolished the protective effect of DY131. The examination of SAH patients' brain samples revealed increases in ERRγ expressions and neuronal apoptosis marker CC3. We concluded that ERRγ activation with DY131 ameliorated oxidative stress and neuronal apoptosis after the experimental SAH. The effects were, at least in part, through the ERRγ/PGC-1α/SIRT3 signaling pathway. ERRγ may serve as a novel therapeutic target to ameliorate EBI after SAH [3)].

1)
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2)
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3)
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